MYH7 gene

myosin heavy chain 7

Normal Function

The *MYH7* gene provides instructions for making a protein known as the cardiac beta (β)-myosin heavy chain. This protein is found in heart (cardiac) muscle and in type I skeletal muscle fibers. Type I fibers, which are also known as slow-twitch fibers, are one of two types of fibers that make up skeletal muscles. Type I fibers are the primary component of skeletal muscles that are resistant to fatigue. For example, muscles involved in posture, such as the neck muscles that hold the head steady, are made predominantly of type I fibers.

In cardiac and skeletal muscle cells, the β-myosin heavy chain forms part of a larger protein called type II myosin. Each type II myosin protein consists of two heavy chains (produced from the *MYH7* gene) and two pairs of regulatory light chains (produced from several other genes). The heavy chains each have two parts: a head region and a tail region. The head region, called the motor domain, interacts with a thin filament protein called actin, which is important for cell movement and shape. The long tail region interacts with other proteins, including the tail regions of other myosin proteins.

Type II myosin generates the mechanical force that is needed for muscles to contract. It is integral to muscle cell structures called sarcomeres, which are the basic units of muscle contraction. Sarcomeres are composed of thick filaments made up of type II myosin and thin filaments made up of actin. The overlapping thick and thin filaments attach to each other and release, which allows the filaments to move relative to one another so that muscles can contract. In the heart, regular contractions of cardiac muscle pump blood to the rest of the body. The coordinated contraction and relaxation of skeletal muscles allow the body to move.

Health Conditions Related to Genetic Changes

congenital fiber-type disproportion

familial dilated cardiomyopathy

familial hypertrophic cardiomyopathy

Mutations in the *MYH7* gene are a common cause of familial hypertrophic cardiomyopathy, accounting for up to 35 percent of all cases. This condition is characterized by thickening (hypertrophy) of the cardiac muscle. Although some

people with hypertrophic cardiomyopathy have no obvious health effects, all affected individuals have an increased risk of heart failure and sudden death.

Most *MYH7* gene mutations that cause familial hypertrophic cardiomyopathy change single protein building blocks (amino acids) in the β-myosin heavy chain protein. The altered protein is likely incorporated into the thick filament, but it may not function properly. It is unclear how *MYH7* gene mutations lead to the features of familial hypertrophic cardiomyopathy.

familial restrictive cardiomyopathy

Laing distal myopathy

At least five mutations in the *MYH7* gene have been found to cause Laing distal myopathy. Most of these mutations result in changes in the tail region of the β-myosin heavy chain. Some of these mutations change single amino acids, while others delete a single amino acid from the heavy chain. Changes in the *MYH7* gene probably disrupt the normal function of type II myosin in muscle cells. Specifically, researchers suspect that mutations alter the structure of the tail region of the β-myosin heavy chain. The altered tail region may be unable to interact with other proteins, including the tail regions of other myosin proteins. It is unclear how these changes in the structure and function of myosin lead to progressive muscle weakness in people with Laing distal myopathy.

myosin storage myopathy

At least five mutations in the *MYH7* gene are involved in myosin storage myopathy. This condition causes muscle weakness and is characterized by the formation of protein clumps, which include type II myosin, within type I skeletal muscle fibers. The *MYH7* gene mutations that cause myosin storage myopathy change amino acids in the tail region of cardiac β-myosin heavy chain. Researchers suggest that these mutations impair the proper formation of thick filaments. The abnormal proteins accumulate in type I skeletal muscle fibers, forming the protein clumps characteristic of the disorder. It is unclear how the gene mutations lead to muscle weakness in people with myosin storage myopathy.

other disorders

Mutations in the *MYH7* gene can cause dilated cardiomyopathy. This condition weakens and enlarges the heart, preventing it from pumping blood efficiently. Dilated cardiomyopathy increases the risk of heart failure and premature death. Researchers have found about a dozen *MYH7* gene mutations in people with this condition. These mutations likely disrupt the normal structure and function of type II myosin. Little is known about the connection between abnormal myosin and the signs and symptoms of this disorder.

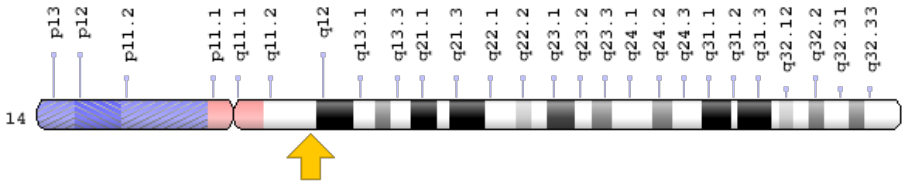
MYH7 gene mutations are also associated with left ventricular noncompaction, another heart muscle disorder that occurs when the lower left chamber of the heart (left ventricle) does not develop correctly. The heart muscle is weakened and cannot pump blood efficiently, often leading to heart failure. Abnormal heart rhythms (arrhythmias) can also occur in people with this condition. At least 10 *MYH7* gene mutations have been found in people with left ventricular noncompaction, although it is unclear what role these mutations play in the disorder.

Researchers are working to determine why some of the conditions that result from *MYH7* mutations predominantly affect cardiac muscle and others predominantly affect skeletal muscle.

Chromosomal Location

Cytogenetic Location: 14q11.2, which is the long (q) arm of chromosome 14 at position 11.2

Molecular Location: base pairs 23,412,738 to 23,435,686 on chromosome 14 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- beta-myosin heavy chain
- MGC138376
- MGC138378
- MPD1
- MYH7_HUMAN
- MyHC-beta
- myhc-slow
- MYHCB
- myosin heavy chain (AA 1-96)
- Myosin heavy chain 7

- Myosin heavy chain, cardiac muscle beta isoform
- Myosin, cardiac, heavy chain, beta
- myosin, heavy chain 7, cardiac muscle, beta
- myosin, heavy polypeptide 7, cardiac muscle, beta
- SPMD
- SPMM

Additional Information & Resources

Educational Resources

- Molecular Biology of the Cell (fourth edition, 2002): Actin-based Motor Proteins Are Members of the Myosin Superfamily
  https://www.ncbi.nlm.nih.gov/books/NBK26888/#A3042
- Molecular Biology of the Cell (fourth edition, 2002): Muscle Contraction Depends on the Sliding of Myosin II and Actin Filaments
  https://www.ncbi.nlm.nih.gov/books/NBK26888/#A3065
- Molecular Cell Biology (fourth edition, 2000): Myosin: The Actin Motor Protein
  https://www.ncbi.nlm.nih.gov/books/NBK21724/
- Neuromuscular Disease Center, Washington University: Myosin and associated muscle proteins
  http://neuromuscular.wustl.edu/mother/myosin.htm
- The Cell: A Molecular Approach (second edition, 2000): Muscle Contraction
  https://www.ncbi.nlm.nih.gov/books/NBK9961/#A1791

GeneReviews

- Dilated Cardiomyopathy Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1309
- Hypertrophic Cardiomyopathy Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1768
- Laing Distal Myopathy
  https://www.ncbi.nlm.nih.gov/books/NBK1433

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28MYH7%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1800+days%22%5Bdp%5D

OMIM

- CARDIOMYOPATHY, DILATED, 1S
  http://omim.org/entry/613426
- MYOSIN, HEAVY CHAIN 7, CARDIAC MUSCLE, BETA
  http://omim.org/entry/160760

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_MYH7.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=MYH7%5Bgene%5D
- HGNC Gene Family: Myosin heavy chains
  http://www.genenames.org/cgi-bin/genefamilies/set/1098
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=7577
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/4625
- UniProt
  http://www.uniprot.org/uniprot/P12883

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